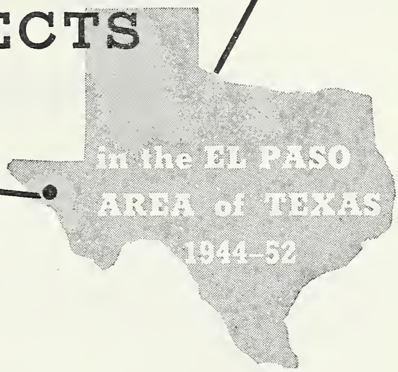
Investigations of the PINK BOLLWORM and HEMIPTEROUS COTTON INSECTS



By L. W. Noble

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Investigations of the PINK BOLLWORM and HEMIPTEROUS COTTON INSECTS in the El Paso Area of Texas, 1944–52[1,2]

By L. W. Noble, *entomologist, Entomology Research Branch, Agricultural Research Service*

In cooperation with the Texas Agricultural Experiment Station

The El Paso Valley of Texas comprises the narrow strip of irrigable land along the Rio Grande in El Paso and Hudspeth Counties. The adjacent land lying across the river in Mexico is called the Juarez Valley. The contiguous valley on the northwest lies in Dona Ana County, N. Mex., and is known as the Mesilla Valley. Cotton production in this area was started on a small scale in 1918 with the planting of a few hundred acres. The acreage was increased rapidly within the next several years.

The pink bollworm (*Pectinophora gossypiella* (Saund.)) was first found in the El Paso area in 1920 after its discovery in the Big Bend area (Presidio and Brewster Counties) in 1918. The Big Bend was in a noncotton zone for the years 1919 and 1920. Cotton plantings were made in 1921, and infestation was found at nearly all points. This reappearance of the insect in the Big Bend and the finding of a widely distributed infestation in the El Paso Valley indicated that moths were moving into these areas from the interior of Mexico. Infestation in the Big Bend soon became much more intense than in the El Paso area, and by 1927 it was deemed advisable to establish at Presidio a pink bollworm research laboratory, the first in this country. Most of the research on this pest was concentrated in the Presidio Valley until changing conditions made it advisable to conduct investigations in other areas. In the fall of 1944 a sublaboratory was established at Fabens, and in 1947 it was transferred to Ysleta. In addition to the pink bollworm investigations, work was done with other cotton insects that occur in the El Paso area. The investigations conducted from 1944 to 1952, together with pertinent previous data on pink bollworm infestation, are described in this circular.

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[1] Submitted for publication November 24, 1954.

[2] This study was conducted under the direction of A. J. Chapman. Others who assisted were J. C. Clark, W. L. Lowry, and Q. A. Hare of the Entomology Research Branch. Acknowledgment is made to P. J. Lyerly of the Ysleta substation of the Texas Agricultural Experiment Station for his valuable assistance.

THE PINK BOLLWORM

History of Infestation in the El Paso Area

Early work on the pink bollworm in the El Paso area consisted primarily in the collection of data necessary for establishing appropriate quarantine regulations. The probability of infestation being introduced into the area was recognized, and field inspections were begun in 1918. They were continued through the 1919 crop season with negative results. The 1920 crop showed a light infestation throughout the area from Anthony, N. Mex., to southeastern Hudspeth County in Texas.

Buildup Over a Long Period

Various methods of inspection during the following years showed a slow buildup in infestation with marked fluctuation from year to year. Decided increases were recorded in 1931, 1938, and 1943, and some fields showed considerable damage in 1943–44.

Following gin-trash inspection in 1931 quarantine regulations designated the lower part of Hudspeth County as a heavily infested area in 1931 and the rest of this county and El Paso and Dona Ana Counties as lightly infested. Records for later years indicated a shifting of the heavier infestation up the valley. The 1941 crop showed a heavy infestation in the lower part of El Paso County and the upper part of Hudspeth County, but the following year there was a decrease. The new high level of infestation in 1943–44 led to a revision of Federal regulations on November 9, 1944, to include all of El Paso County except the extreme western part in the heavily infested area. The Mesilla Valley remained lightly infested.

Rapid Decline After 1944

Surveys of infestations in green bolls were made in the El Paso and Juarez Valleys from 1944 to 1951. The counts were made in the same fields or near the same points each year. Counts for the first 2 years were lacking for some of the fields. Beginning in 1946 the records were standardized on 20 fields for the El Paso Valley and 21 for the Juarez Valley. Counts made at 15-day intervals showed a progressive seasonal buildup until the maximum percentage of infested bolls and the highest larval population were reached in October. The October records for the El Paso and Juarez Valleys are shown in table 1.

The year 1945 showed a marked decrease in infestation from the high level of 1944, which was followed by some increase in 1946. In the next 3 years there was a continuous decrease, but the 1949 low level continued with only slight fluctuation through 1951. It is not known when the infestation was previously as low as the 1949–51 level, but available records show that it was prior to 1938.

The decrease in infestation after 1944 is attributed to a number of factors, including climatic conditions, improved cultural practices (especially in Mexico), the use of DDT for general cotton insect control, and the shortage of irrigation water which greatly reduced cotton production in the lower part of the Juarez Valley. The unusually cold winters in 1947–49 were responsible for the continuous decrease in infestation during that period.

TABLE 1.—*Pink bollworm infestation in the El Paso and Juarez Valleys in the month of October, 1944–51*

EL PASO VALLEY

Year	Fields inspected	Bolls per plant	Bolls infested	Larvae per acre
	Number	*Number*	*Percent*	*Number*
1944	17	4. 7	52. 7	145, 182
1945	17	4. 5	22. 2	27, 180
1946	20	3. 3	31. 1	36, 715
1947	20	4. 4	13. 0	20, 843
1948	20	5. 0	16. 0	27, 020
1949	20	3. 1	. 3	283
1950	21	3. 5	2. 3	1, 612
1951	21	2. 8	1. 8	1, 305

JUAREZ VALLEY

Year	Fields inspected	Bolls per plant	Bolls infested	Larvae per acre
1944	12	4. 4	42. 2	70, 920
1945	7	5. 4	29. 3	52, 317
1946	19	2. 4	53. 4	47, 651
1947	22	3. 8	45. 1	53, 558
1948	22	4. 2	30. 5	43, 281
1949	22	2. 7	11. 9	7, 741
1950	22	2. 6	16. 8	9, 442
1951	21	3. 0	9. 1	5, 530

Infestation in the El Paso Valley frequently is increased by moth migration from the Juarez Valley. Cotton is generally planted earlier on the American side of the river than on the Mexican side, and early-emerging moths from late-planted fields in Mexico migrate to nearby early plantings in Texas. Table 1 shows higher infestation in the Juarez Valley than in the El Paso Valley except in 1944 and 1945. These exceptions probably were due to insufficient records for the heavily infested upper part of the Juarez Valley in those 2 years. Increased control through improved cultural practices in this valley during the later years was due to the general prosperity resulting from higher cotton prices. Cleaner picking of the fields and greater use of tractor plows reduced the number of pink bollworms that lived over the winter.

Table 2 shows infestation records for different localities in the El Paso Valley and adjacent areas in the Juarez Valley. These localities showed fluctuations from year to year that were sometimes out of line with the infestation of the areas as a whole. For example, in 1948 the area from the Hudspeth County line to Fort Hancock showed a high increase over 1947, whereas practically all other localities showed a decrease. This high increase was attributed to late planting and also to less acreage than the previous year in the adjacent San Ignacio-Porviner area of Mexico, resulting in greater early-moth migration to the Texas area.

Table 2.—*Pink bollworm infestation for various localities in the El Paso and Juarez Valleys in the month of October, 1944-51*

EL PASO VALLEY

Locality and year	Fields inspected	Bolls per plant	Bolls infested
	Number	*Number*	*Percent*
El Paso to Fabens:			
1944	0	----------	----------
1945	0	----------	----------
1946	3	3. 9	50. 7
1947	3	5. 0	6. 7
1948	3	3. 4	11. 3
1949	3	3. 0	0
1950	3	3. 3	1. 3
1951	3	3. 7	. 3
Fabens to Hudspeth County:			
1944	6	6. 5	74. 5
1945	6	5. 5	37. 5
1946	6	3. 2	53. 5
1947	6	4. 8	31. 2
1948	6	4. 3	16. 7
1949	6	2. 9	. 3
1950	6	2. 9	3. 3
1951	6	1. 9	2. 5
Hudspeth County line to Fort Hancock:			
1944	5	4. 9	59. 4
1945	5	3. 5	25. 4
1946	5	3. 5	21. 6
1947	5	3. 3	8. 0
1948	5	4. 9	37. 0
1949	5	2. 8	1. 0
1950	5	3. 8	. 4
1951	5	3. 4	0
Fort Hancock to Fort Quitman:			
1944	6	2. 8	25. 3
1945	6	4. 4	4. 3
1946	6	2. 7	6. 8
1947	6	4. 7	2. 3
1948	6	6. 5	. 3
1949	6	3. 6	0
1950	7	3. 9	3. 3
1951	7	2. 9	3. 1

JUAREZ VALLEY

Locality and year	Fields inspected	Bolls per plant	Bolls infested
Juarez to Guadalupe:			
1944	4	3. 7	41. 5
1945	0	----------	----------
1946	7	2. 7	64. 3
1947	9	3. 8	60. 0
1948	9	4. 0	46. 5
1949	9	3. 2	23. 1
1950	9	3. 3	23. 5
1951	9	2. 8	15. 5
Guadalupe to San Ignacio:			
1944	3	4. 4	71. 7
1945	2	3. 7	85. 0
1946	4	1. 7	94. 2
1947	5	3. 9	62. 8
1948	5	3. 7	42. 8
1949	5	3. 4	8. 8
1950	5	2. 8	15. 6
1951	5	2. 4	9. 4

TABLE 2.—*Pink bollworm infestation for various localities in the El Paso and Juarez Valleys in the month of October, 1944-51*—Continued

JUAREZ VALLEY—continued

Locality and year	Fields inspected	Bolls per plant	Bolls infested
San Ignacio to Porviner:	*Number*	*Number*	*Percent*
1944	3	5.4	26.3
1945	3	5.5	9.3
1946	5	2.3	35.8
1947	5	3.1	27.0
1948	5	4.6	7.4
1949	5	1.1	1.8
1950	5	1.5	12.0
1951	5	3.8	0
Porviner to Cedillos:			
1944	2	4.1	23.5
1945	2	7.0	3.5
1946	3	2.9	2.7
1947	3	4.9	1.0
1948	3	5.1	.3
1949	3	2.8	0
1950	3	1.2	6.3
1951	2	4.0	2.5

Shortage of irrigation water greatly affected the agriculture of the lower part of the Juarez Valley, because the upper area used most of the water supply, and this situation became worse as the years passed. Lack of water first caused delayed planting from Guadalupe to Cedillos. Later the acreage was reduced in that locality. No doubt this situation reduced pink bollworm infestations on both sides of the river, since the Mexico area previously supplied large numbers of moths that infested early cotton in the adjacent El Paso Valley.

Winter Survival

The low infestation for a number of years after the pink bollworm was discovered in the El Paso area led to speculation as to whether or not the insect overwintered there. It was generally believed that the population died out during the winter months, except possibly in unusually mild winters, and was reestablished during the growing season by moth flight from the Presidio area or the interior of Mexico. This belief was proved to be erroneous by data obtained in early-season bloom inspection and hibernation experiments discussed below.

Early-Bloom Inspection

Early-season blooms were inspected annually in the El Paso and Juarez Valleys from 1944 to 1951 to obtain an index of the winter carryover and to find fields with the heaviest infestations for use in insecticide experiments.

Fenton and Owen [3] and A. J. Chapman and others (unpublished

[3] FENTON, F. A., and OWEN, W. L., JR. THE PINK BOLLWORM OF COTTON IN TEXAS. Tex. Agr. Expt. Sta. Misc. Pub. 100, 39 pp. 1953. [Processed.]

reports) in moth-migration studies in the Big Bend found little activity early in the season or until the crop began to mature. The greatest activity, as indicated by the number of moths collected on flight screens, was in September and October. Of 90 trap plantings on ranch land north of the Big Bend, 18 became infested. Plots near Van Horn, 35 miles from the nearest cotton in the Presidio Valley, became infested in 4 of the 6 years. Some of the infested plots were 65 miles from the nearest cotton. None of the plots became infested before the last part of September. It is therefore reasonable to assume that any infestation found in early-season blooms is due entirely to local carryover.

The bloom records, as summarized in table 3, show the same general trend in infestation level as the boll records in table 1. After 3 unusually cold winters, 1949 showed the lowest carryover, which was in accord with the late-season boll infestation. No larvae were found in early-season blooms on the Texas side of the river in 1949–51, although large numbers of blooms were examined. The 1950 and 1951 increase in infested blooms was exaggerated because inspections were concentrated in the heavily infested areas in an attempt to find fields for insecticide tests.

Table 3.—*Pink bollworm infestation in early blooms in the El Paso and Juarez Valleys, 1944–51*

Year	Fields inspected	Blooms examined	Larvae per 100,000 blooms
	Number	*Number*	*Number*
1944	32	23, 991	500
1945	54	73, 022	137
1946	127	292, 978	71
1947	103	261, 063	41
1948	92	266, 552	63
1949	146	407, 365	2
1950	100	147, 158	40
1951	93	104, 330	93

Hibernation Experiments

The first record of winter survival of the pink bollworm in the El Paso area was obtained in a small-scale experiment conducted in the Juarez Valley with heavily infested bolls collected there in 1940. A similar experiment the following year in the El Paso Valley established the fact that the insect was capable of surviving the winter in the area.

Experiments were conducted from 1945 to 1952 to determine pink bollworm survival and time of moth emergence in different environments simulating conditions under various cultural practices. These experiments were conducted on medium heavy soil commonly called adobe. The tests included treatments of larvae as follows: (1) Larvae in open bolls on soil surface buried on December 15, some buried on March 15, and others remaining on the soil surface, and bolls on standing stalks buried on March 15; and (2) larvae in free cocoons on soil surface buried on December 15, some buried on March 15, and others

remaining on the soil surface. An estimate of the number of larvae in the experiments was obtained by examining samples of the bolls and cocoons at the time they were placed in cages in the fall. The cages were equipped with moth traps in the spring, and daily records were made on moth emergence for computing the percentage of survival.

Previous work in the Presidio Valley showed that very few moths emerged from larvae buried 6 inches. It was therefore concluded that study of deep burial was not warranted in these experiments. Half of the larvae in each treatment were buried 2 inches and the other half 4 inches. Irrigation water was applied the first of April, and 2 to 3 later irrigations were made during the summer as needed to stimulate pupation.

Table 4 indicates that winter carryover in free cocoons is of minor importance. The survival in bolls averaged 12.8 percent for all treatments over the 8-year period. Survival in the December burial was less than in the March burial. Survival was the lowest in bolls on standing stalks that remained above ground during the coldest months, 0.94 percent in this environment compared with 18.4 percent in bolls on the soil surface that were buried on the same date.

In the El Paso area moths that emerge prior to June 1 die before cotton is sufficiently advanced for their propagation. It will be noted

TABLE 4.—*Percent survival of pink bollworms in hibernation experiments in the El Paso Valley, 1945–52*

LARVAE IN OPEN BOLLS

Year	On soil surface			On standing stalks buried Mar. 15	Average
	Buried Dec. 15	Buried Mar. 15	Not buried		
1945	17. 6	19. 4	30. 5	4. 93	18. 1
1946	24. 7	25. 5	15. 5	. 16	16. 5
1947	10. 5	11. 2	19. 9	. 41	10. 5
1948	2. 4	3. 7	8. 9	. 57	3. 9
1949	2. 8	6. 5	6. 5	. 83	4. 2
1950	16. 6	28. 8	16. 2	. 23	15. 4
1951	25. 1	33. 3	25. 5	. 10	21. 0
1952	9. 4	18. 5	23. 0	. 30	12. 8
Average	13. 6	18. 4	18. 2	. 94	12. 8

LARVAE IN FREE COCOONS

1945	1. 82	1. 52			1. 67
1946	1. 22	1. 41	2. 34		1. 66
1947	. 70	1. 09	1. 25		1. 01
1948	3. 05	2. 37	2. 95		2. 79
1949	. 88	. 61	1. 42		. 97
Average	1. 53	1. 40	1. 99		1. 62

331485°—55——2

in table 5 that over half of the emergence had occurred by the end of May except in bolls on the soil surface. March burial delayed emergence slightly more than December burial. Bolls on the soil surface dried rapidly after irrigation, and the lack of moisture to stimulate pupation delayed emergence. Most of the moths from these bolls emerged in July and August and some of them not until September.

TABLE 5.—*Cumulative percentages of pink bollworm moths that emerged in hibernation experiments in the El Paso Valley, 1945–52*

LARVAE IN OPEN BOLLS

Month	On soil surface			On standing stalks buried Mar. 15
	Buried Dec. 15	Buried Mar. 15	Not buried	
April	0. 6	0. 3	0. 1	1. 6
May	63. 0	56. 8	7. 0	62. 7
June	90. 0	88. 0	31. 9	84. 9
July	99. 0	99. 5	76. 0	95. 7
August	100	99. 9	96. 6	100
September	----------	100	100	----------
Seasonal survival	13. 6	18. 4	18. 2	. 9

LARVAE IN FREE COCOONS [1]

Month	Buried Dec. 15	Buried Mar. 15	Not buried	On standing stalks buried Mar. 15
		0		
April	0	9	0	----------
May	83. 6	86. 8	68. 7	----------
June	95. 1	99. 3	93. 0	----------
July	100	90. 5	99. 5	----------
August	----------	10	100	----------
September	----------	----------	----------	----------
Seasonal survival	1. 5	1. 4	2. 0	----------

[1] Tests conducted in 1945–49.

Effects of Fall and Winter Weather

Climatological data obtained at the location of the hibernation experiments are summarized in table 6. Temperatures in the El Paso Valley usually were lower than the Weather Bureau records for El Paso. There was a wide range in pink bollworm survival in the hibernation experiments, which is attributed to weather conditions. In January 1947 the temperature remained below 32° F. for 136 hours with a low of 4°. A low of −6° occurred in both the valley and El Paso in January 1948, which was an alltime low for the area. The temperature dropped below zero again in January 1949 with the recording of −2°. Each of these three cold winters caused a decrease in winter survival, which was accompanied by a rapid decline in infestation for the area.

Weather and fruiting conditions of the plants at the time of the first frosts in the fall influence the number of hibernating larvae. When

TABLE 6.—*Climatological data at the location of pink bollworm hibernation experiments in the El Paso Valley, 1944–52*

Winter	Temperature (°F.)									Rainfall (inches) November through February
	Low for winter	November		December		January		February		
		Low	Average	Low	Average	Low	Average	Low	Average	
1944–45	-----	-----	------	-----	------	18	43. 2	17	48. 6	--------
1945–46	6	19	51. 2	12	42. 7	11	39. 7	6	45. 2	0. 75
1946–47	4	21	48. 9	18	44. 5	4	38. 4	18	46. 8	1. 92
1947–48	−6	21	47. 3	11	38. 3	−6	39. 5	15	45. 8	1. 00
1948–49	−2	10	45. 5	14	45. 9	−2	35. 5	11	45. 4	3. 39
1949–50	10	26	53. 8	10	39. 5	14	46. 6	27	51. 1	1. 88
1950–51	6	11	52. 4	15	47. 4	14	42. 7	6	46. 2	1. 06
1951–52	16	18	50. 0	17	45. 7	16	49. 8	16	46. 9	1. 07

light frosts persist for a number of days before subfreezing temperature, the mortality in succulent bolls is negligible, whereas a sudden freeze following warm weather results in a high mortality. A sudden drop in temperature to 24° and 21° F. on November 8 and 9 in the Presidio Valley caused 98-percent mortality in green bolls. Similar temperatures occur more frequently in the El Paso Valley, where many bolls are green at frost date. When temperatures are low enough to freeze these bolls, the pink bollworm population is greatly reduced.

Insecticide Experiments

The low pink bollworm infestation after 1944 did not provide an opportunity for obtaining information as to the increase in cotton yield from control of the insect with insecticides. However, experiments were conducted in the El Paso and Juarez Valleys to determine the effectiveness of various insecticides based on reduction in larval population.

Large Plots

In 1945 DDT emulsions were applied by airplane on 15-acre plots comprising a total of 150 acres. The experiments were designed to test different dosages of DDT and also to compare different volumes of spray containing equal amounts of DDT. The applications were made at weekly intervals. As shown in table 7 all the treatments caused a high percentage reduction in larvae, and there was little difference in effectiveness between 1.25 and 2.5 pounds of DDT per acre. A spray volume of 2.5 gallons per acre was as effective as 5 gallons.

Small Plots

During the 1946–51 experiments various insecticides were applied with hand dusters and sprayers, usually on plots of 1/5 to 1/4 acre, each treatment being replicated 4 times. Infestation counts were made

TABLE 7.—*Comparisons of 2 dosages of DDT and 2 volumes of spray against the pink bollworm in the El Paso Valley, 1945*

Experiment	Dates of application	Treatment per acre		Bolls infested	Larvae per boll	
		DDT	Volume of spray		Number	Reduction below check
		Pounds	*Gallons*	*Percent*		*Percent*
1	Sept. 1, 8, 15, 22, Oct. 1, 8.	1.25	2.5	3.2	0.04	90
		1.25	5.0	4.2	.06	87
		2.50	5.0	1.9	.02	95
		Untreated check		20.0	.45	
2	Sept. 8, 15, 22, Oct. 1, 8.	1.25	2.5	1.9	.03	95
		1.25	5.0	1.1	.01	97
		2.50	5.0	1.6	.02	96
		Untreated check		21.1	.58	

every 2 weeks. Usually the insecticides were applied at weekly intervals, but 2 experiments were conducted to determine whether the infestation would be materially reduced or limited by only 2 heavy applications of DDT 2 weeks apart. Infestation counts for each of these 2 experiments covered a period of 6 weeks following the first application.

These experiments are summarized in table 8. DDT and methoxychlor were the most effective materials for practical use; the former was more satisfactory because of its lower cost and its availability. The limited tests with EPN showed promising results. Toxaphene and BHC were not sufficiently effective, but showed some benefit in pink bollworm control when mixed with DDT.

The great reduction sometimes obtained with low dosages of DDT is attributed to the light infestation of the area with little moth migration, and the fact that the experiments were conducted late in the season, which increased the residual effect due to cool temperature. Experiment 5 in 1946 and experiment 1 in 1950 are noteworthy in that they show a high reduction in infestation from only 2 heavy applications 2 weeks apart.

HEMIPTEROUS COTTON INSECTS

Hemipterous cotton insects in the El Paso area build up on alfalfa and later move to cotton. Consequently the population is greatly influenced by the amount of land planted to alfalfa, especially the acreage producing a seed crop. In sweepings with a net the following insects were found throughout the growing season:

Tarnished plant bug (*Lygus lineolaris* (P. de B.))
Legume bug (*Lygus hesperus* Knight)
Superb plant bug (*Adelphocoris superbus* (Uhl.))
Say stink bug (*Chlorochroa sayi* Stål)
Conchuela (*Chlorochroa ligata* (Say))
Red-shouldered stink bug (*Thyanta custator* (F.))

Brown cotton bug (*Euschistus impictiventris* (Stål))
Arhyssus lateralis (Say)
Liorhyssus hyalinus (F.)
Cotton fleahopper (*Psallus seriatus* (Reut.))
Ragweed plant bug (*Chlamydatus associatus* (Uhl.))

The *Lygus* species are the most abundant. Stink bugs sometimes build up sufficiently to cause serious damage. *Arhyssus lateralis* and *Liorhyssus hyalinus* are less important. The cotton fleahopper is of little consequence. Although the ragweed plant bug, or "black fleahopper," occurs in relatively large numbers, it appears to cause negligible damage and therefore is excluded from population counts to determine the need for insecticide application.

Surveys To Determine Seasonal Abundance

Weekly population counts of the injurious Hemiptera on alfalfa and cotton were made from Clint to Fort Hancock during the growing seasons of 1946–51. The number of specimens per 100 sweeps with a 16-inch net was recorded. Sweepings on alfalfa were begun the first of April and discontinued when cotton plants became large enough for satisfactory sweepings in June. Records were obtained from 10 fields each of alfalfa and cotton. The same fields or ones in close proximity were used from year to year.

The survey records are summarized in table 9. There was a great increase in hemipterous insects in 1947 over 1946. A decline in population began the next year and continued with slight yearly fluctuations through 1951. The 1947 increase is attributed primarily to greater acreage of alfalfa seed crop than in the previous year. The alfalfa acreage was decreased in later years and the production of seed was almost entirely discontinued. This change in alfalfa production together with greater use of organic insecticides accounts for the low infestations of hemipterous insects in the later years. The sweep records show that a damaging infestation on cotton may appear the last part of June and continue through August. Decrease in infestation due to natural causes usually begins about the middle of August.

Insecticide Experiments

Insecticide experiments against hemipterous insects on cotton were conducted during 1946–51. There was ample irrigation water to keep the plants in fruiting condition over a long growing season; thus the plants could tolerate some shedding of squares and young bolls due to insect injury without a reduction in yield. Many of the experiments failed to show an increase in yield, either because of the prevailing low infestation or because of difference in soil fertility between plots. The insects were predominately *Lygus* species. Few stink bugs were present.

Two experiments conducted in 1947 and two in 1950 are typical of the group. In 1947 a field of 31 acres was treated by airplane with a dust containing 5 percent of DDT and 75 percent of sulfur, and an adjoining 14-acre field was left untreated as a check. In another experiment a similar DDT-sulfur dust and one containing 10 percent of toxaphene plus 75 percent of sulfur were applied by a tractor duster. Three plots had been staked off, a 4.6-acre untreated check lying be-

Table 8.—*Summary of experiments with insecticides applied against the pink bollworm in the El Paso and Juarez Valleys, 1946–51*

Year and experiment	Dates of application	Treatment: Insecticide	Treatment: Active ingredient per acre	Bolls infested	Larvae per boll: Number	Larvae per boll: Reduction below check
1946			*Pounds*	*Percent*		*Percent*
1	Sept. 3, 11, 18, 25, Oct. 2, 19	DDT dust	0.79	48	0.97	63
			4.85	20	.35	87
			2.76	29	.40	84
			2.56	29	.47	82
			1.40	37	.57	78
		Untreated check		79	2.56	
2	Sept. 20, 26, Oct. 8	DDT dust	1.97	68	1.69	36
			4.04	48	.99	63
		Untreated check		79	2.67	
3	Sept. 3, 11, 18, 25, Oct. 2, 9	Dusts:				
		Sabadilla	3.46	88	4.87	17
		Ryania	9.12	87	4.39	25
		DDT	2.44	60	1.32	77
		BHC, gamma	.57	78	3.11	47
			1.08	75	2.64	55
		Untreated check		90	5.87	
4	Sept. 20, 26, Oct. 8	Dusts:				
		DDT	.93	73	2.24	24
			1.65	72	2.12	28
		BHC, gamma	.56	65	1.78	40
			.93	56	1.23	58
		Ryania	7.12	72	1.91	35
		Untreated check		85	2.97	
5	Aug. 27, Sept. 10	DDT spray	6.4	67	1.67	88
		Untreated check		100	14.52	
1947						
		Dusts:				
		Toxaphene	4.01	28	5.20	3
		Chlordane	4.77	29	4.60	8

1	Sept. 18, 25, Oct. 2, 9	DDT	2.01	24	4.17	17
		DDT+toxaphene	1.17+2.35	24	4.04	19
		DDT+BHC, gamma	1.12+ .67	28	3.97	21
		Untreated check		29	5.04	
1948						
1	Aug. 19, 26, Sept. 2, 12, 20, 28	Dusts:				
		Toxaphene+BHC, gamma	1.75+ .35	28	.89	81
		DDT+toxaphene	1.80+1.80	20	.46	90
		DDT+chlordane	1.95+ .97	20	.40	91
		Toxaphene	3.20	41	1.63	65
		Methoxychlor	1.78	24	.75	84
		Untreated check		70	4.79	
2	Aug. 27, Sept. 3, 16, 23, Oct. 7	Dusts:				
		DDT+BHC, gamma	3.68+ .37	9	.17	90
			1.74+ .35	9	.13	92
		DDT	3.68	7	.12	92
		DDT+parathion	1.87+ .37	9	.17	90
		Methoxychlor+BHC, gamma	1.79+ .36	11	.19	89
		Untreated check		53	1.69	
3	Aug. 19, Sept. 1, 12	DDT+BHC, gamma, dust	5.14+ .51	14	.35	89
			2.31+ .46	15	.37	89
		Untreated check		66	3.41	
1949						
1	Sept. 1, 12, 17, 26, Oct. 4	Dusts:				
		DDT+BHC, gamma	2.3 + .46	8	.18	98
		DDT+toxaphene	2.0 +2.0	7	.10	99
		Sprays:				
		DDT+BHC, gamma	2.1 + .41	4	.06	99
		DDT+toxaphene	2.0 +2.0	6	.09	99
		Untreated check		32	.87	
1950						
1	Aug. 22, Sept. 6	DDT spray	3.0	23	.40	90
			6.0	16	.27	93
		Untreated check		65	3.94	
1951						
1	Aug. 21, 28, Sept. 4, 11, 20, Oct. 1	Sprays:				
		DDT+EPN	1.5 + .3	6.8	.08	97
			.47+ .47	5.7	.08	97
		DDT+BHC, gamma	1.40+ .28	8.2	.13	95
		DDT	1.82	11.6	.21	92
		Untreated check		55.5	2.76	

TABLE 9.—*Records of injurious hemipterous insects collected in weekly sweepings in 10 fields each of alfalfa and cotton in the El Paso Valley, 1946–51*

ALFALFA

Date	Average number per 100 sweeps					
	1946	1947	1948	1949	1950	1951
Week in April:						
1st	--------	--------	--------	--------	12. 2	4. 4
2d	--------	37. 5	--------	8. 4	31. 8	3. 1
3d	13. 3	103. 1	21. 8	12. 0	35. 9	9. 9
4th	49. 3	185. 2	78. 2	59. 9	87. 0	25. 4
Week in May:						
1st	73. 0	168. 0	77. 0	73. 9	36. 6	33. 5
2d	63. 1	175. 0	40. 2	59. 3	27. 9	60. 7
3d	31. 9	62. 4	--------	65. 5	16. 5	109. 2
4th	24. 8	33. 8	9. 0	15. 1	22. 1	21. 0
Week in June:						
1st	50. 2	68. 0	15. 1	34. 3	43. 0	28. 5
2d	71. 4	156. 3	55. 9	106. 4	64. 6	45. 6
3d	--------	--------	55. 8	80. 4	91. 6	59. 1

COTTON

Date	1946	1947	1948	1949	1950	1951
June 20	--------	--------	3. 2	14. 2	2. 8	. 1
27	--------	12. 5	6. 2	6. 9	2. 2	. 4
July 5	--------	8. 8	5. 6	10. 1	2. 7	. 7
11	--------	9. 9	4. 2	5. 4	6. 3	1. 0
18	--------	46. 9	4. 8	3. 9	9. 0	3. 1
25	--------	34. 8	10. 2	3. 5	8. 1	2. 9
Aug. 1	--------	34. 2	9. 1	3. 3	10. 3	. 3
9	--------	20. 4	10. 0	2. 2	6. 1	2. 0
16	--------	15. 0	6. 8	. 8	2. 7	1. 2
23	--------	15. 4	5. 7	2. 0	. 6	--------
31	--------	10. 0	2. 0	3. 0	--------	--------

tween two 9.5-acre treated plots. The field had received a sudden heavy migration of hemipterous insects from seed alfalfa just before the poison applications were begun.

In 1950 two identical small-plot experiments were conducted in separate fields to obtain information as to the level of hemipterous-insect infestation that would justify control with insecticides. A DDT-toxaphene spray was applied with hand sprayers equipped with two nozzles per row. There were 6 replicates on ¼-acre plots in each of the 2 experiments.

Infestation counts were made with a 16-inch net, the number of injurious specimens per 100 sweeps being determined weekly for all 4 experiments. The results of these experiments are summarized in table 10.

In 1947 profitable increases in cotton yield were obtained from 3 insecticide applications when the insects averaged 20 and 22 per 100 sweeps. Although this experiment was not replicated, the owner of the farm, who stated that he was reliably informed on past production of the fields, attributed the gain entirely to the poison applications.

Table 10.—*Summary of experiments with insecticides applied against hemipterous cotton insects in the El Paso Valley, 1947 and 1950*

Year and experiment	Dates of application	Treatment: Insecticide	Treatment: Active ingredient per acre	Insects per 100 sweeps: Range	Insects per 100 sweeps: Average	Seed cotton per acre: Yield	Seed cotton per acre: Gain
1947			*Pounds*	*Number*	*Number*	*Pounds*	*Pounds*
1	July 25, Aug. 5, 21	DDT dust	0. 75	3– 8	4	2, 808	326
		Untreated check		9–55	20	2, 482	
2	July 24, 31, Aug. 11	Dusts:					
		DDT	. 75	6–21	13	2, 274	253
		Toxaphene	1. 5	4–13	7	2, 284	263
		Untreated check		8–40	22	2, 021	
1950							
1	July 19, Aug. 4	DDT+toxaphene, spray	0. 75+ . 75	1. 3– 8. 3	4. 6	2, 586	−165
		Untreated check		3. 5–13. 5	9. 6	2, 751	
2	do	DDT+toxaphene, spray	. 75+ . 75	1. 2– 6. 2	3. 5	3, 730	226
		Untreated check		3. 8– 8. 8	6. 3	3, 504	
Difference required for significance at 5-percent level.							446

The 2 experiments in 1950 did not show any increase in cotton yield from insecticide applications when the hemipterous insects averaged 9.6 and 6.3 per 100 sweeps. The sweep records showed that the insect population decreased in the check plots after the first poison application and remained far below the prepoison population for the remainder of the season.

SUMMARY

After the pink bollworm (*Pectinophora gossypiella* (Saund.)) was discovered in the El Paso area in 1920, the infestation built up slowly, but by 1943–44 this insect had caused considerable damage in some fields. During 1945–49 the infestation decreased to a very low level, which continued through 1951, when infestation surveys were discontinued.

In hibernation experiments conducted in 1945–52, the winter survival averaged 12.8 percent for larvae in bolls exposed to 4 different environments. December burial decreased survival under that for bolls remaining on the soil surface until buried in March. The survival in bolls that remained on standing stalks until buried in March was only 0.94 percent compared with 18.4 for bolls buried on the same date after lying on the soil during the winter months. In the course of these experiments the temperature dropped to −6° F., an alltime low for the area. Each of 3 unusually cold winters caused a lower survival than that for other years.

Experiments were conducted with various insecticides to determine their effectiveness based on reduction in larval population. DDT was the most satisfactory. Toxaphene and BHC may give some benefit in the control of this insect when mixed with DDT.

The population of hemipterous insects attacking cotton in the El Paso area is greatly influenced by the amount of land planted to alfalfa, especially the acreage producing a seed crop. Surveys during 1946–51 showed that damaging infestation on cotton may appear the last part of June and continue through August. The insects are predominately *Lygus* species, but stink bugs sometimes build up to serious numbers. Many of the insecticide experiments failed to show an increase in cotton yield because of the prevailing low infestation. Substantial gains were obtained from control of infestations where approximately 20 injurious Hemiptera were obtained per 100 sweeps with a 16-inch net.

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